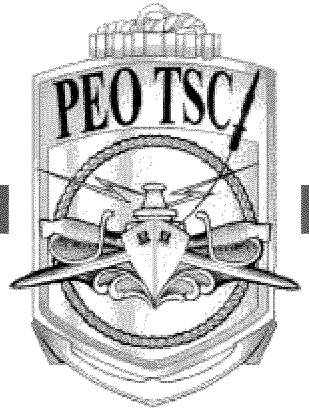

Aegis Combat System Interoperability - Designing, Building and Testing

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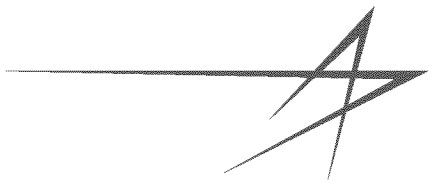
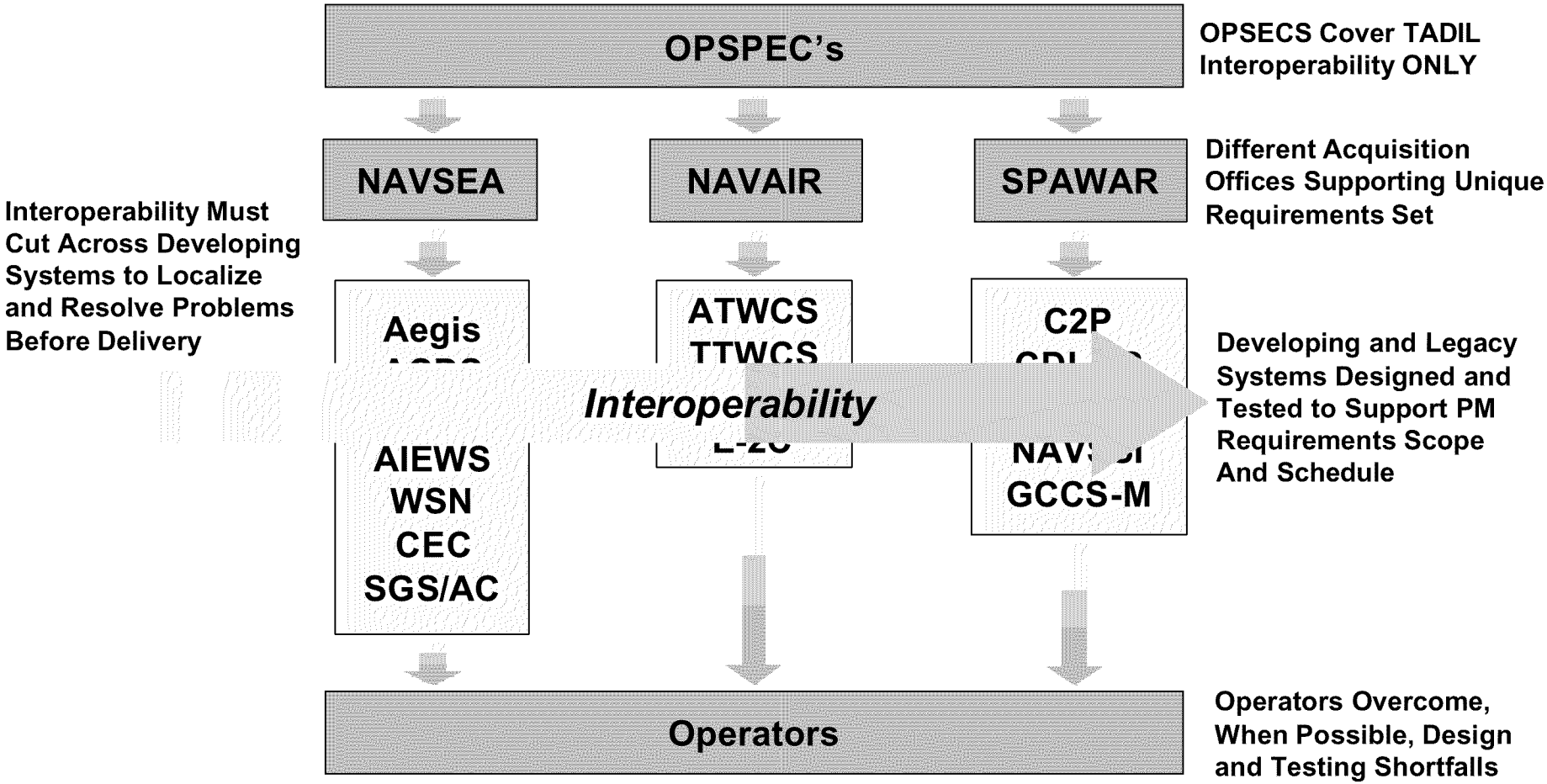
Outline



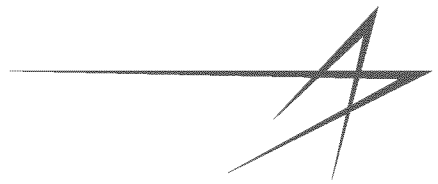
- *Aegis Combat System Engineering Agent (CSEA) View*
- *Aegis Baseline 6 III Interoperability Initiatives*
- *Lessons Learned and Shortfalls*
- *Summary*

Aegis CSEA View



System Development "Business As Usual" will <u>Not</u> Achieve Interoperability Improvement

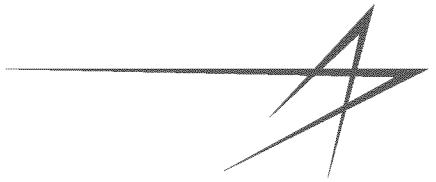
Background



- *CEC OPEVAL events led to formation of an Interoperability Task Force Senior System Engineering Council*
  - *Tasked to resolve System problems, point solution for CEC OPEVAL*
  - *ITF Link/ID/Interoperability team investigated 166 problems and corrected 38 over 17 months*
- *Concurrently PMS 400B asked, How can we improve interoperability during development?*
- *Lockheed Martin developed new test initiative to identify and correct interoperability problems during Baseline 6 Phase III development*

Interoperability Improvement Required Infrastructure and Process Changes, I.e. Not "Business As Usual"

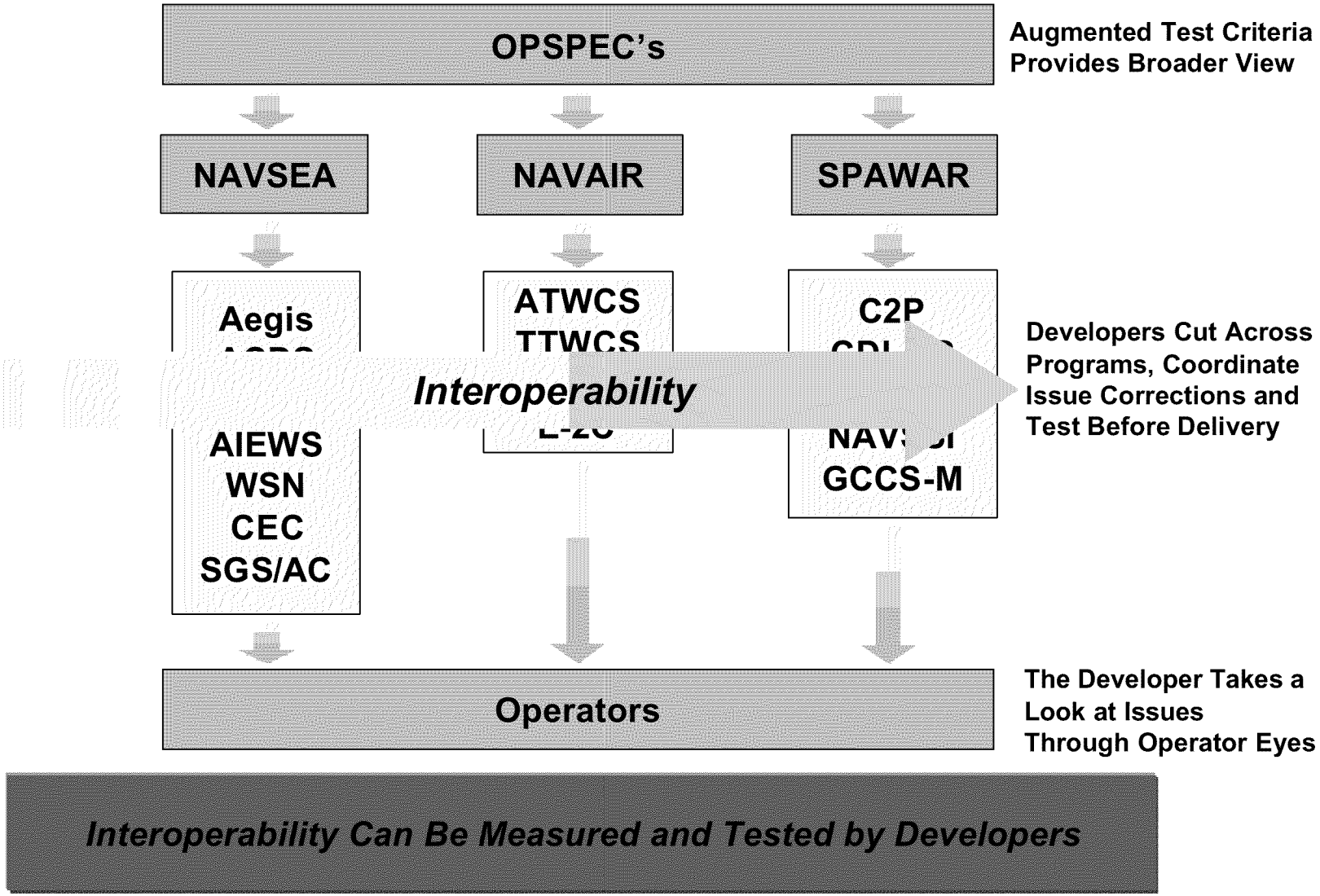
New Test Initiative – What to Do?



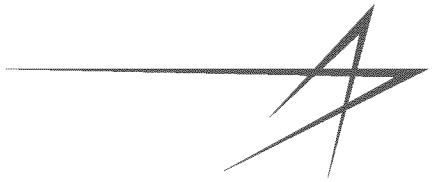
- ***Develop a system test infrastructure that would stimulate multiple systems during development***
  - ***An infrastructure that supported:***
    - ***an ability to generate and distribute common dynamic tracks to be processed by multiple systems.***
    - ***computer generated scenarios that would replicate operationally based experience.***
- ***Develop a robust test criteria with quantitative performance measurements***
- ***Develop test methodologies that facilitate:***
  - ***Iterative cross system problem identification***
  - ***Coordinated developer investigation***
  - **System wide problem resolution and validation**

Move Away From Sterile Single Ship Test Environments, Validating S/W Requirements…. Move towards Testing The Way The Ship Fights

New Test Initiative – How To Do It



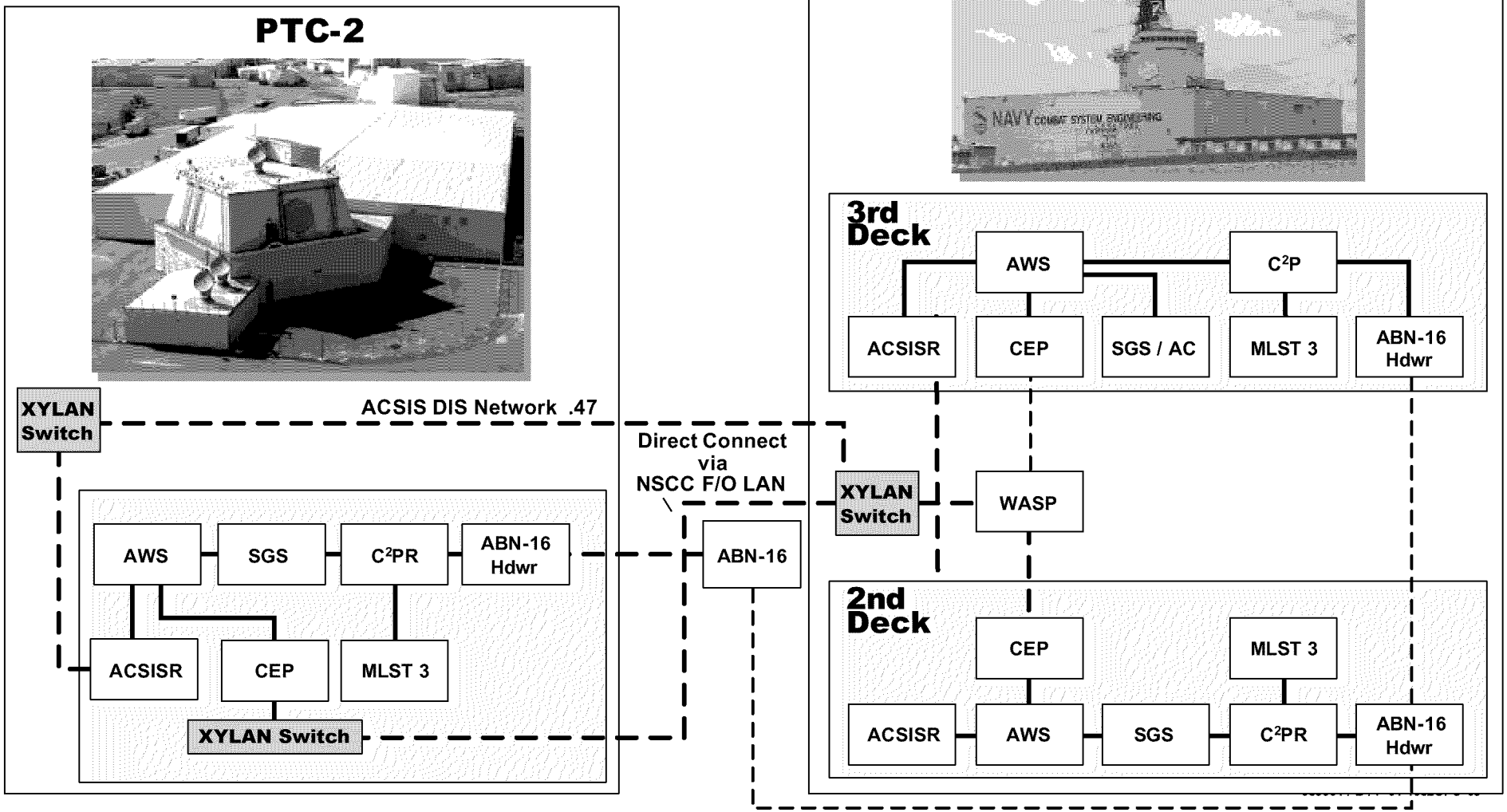
Multi-Aegis Combat System (MACS)



- *High-fidelity interoperability testing using operationally based scenarios on a distributed network*
  - *Distribute tracks via Distribute Interface Simulator (DIS)*
  - *Connect TADILS via Aegis Broadcast Network (ABN-16)*
  - *Connect CEC via secure LAN*
- *Supplements*
  - *Navy Link Certification*
  - *Link exercises with Patriot/THAAD,E-2, ACDS*
- *Provides*
  - *Common sensor environment*
    - *Multi-aircraft , Multi-TBM*
    - *Simultaneous AAW and TBM*

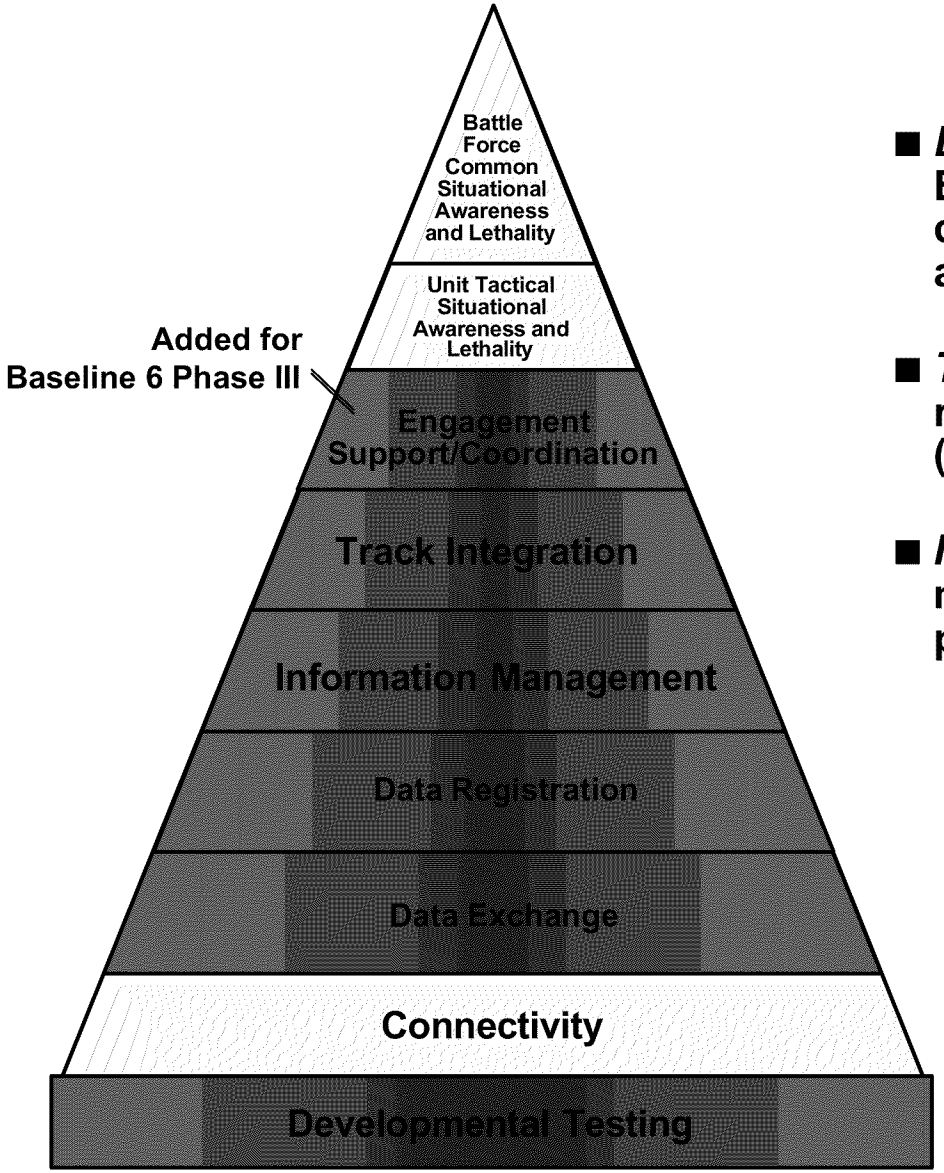
Built Battle Force Rancocas

Battle Force Rancocas



MACS Interoperability Test Goals

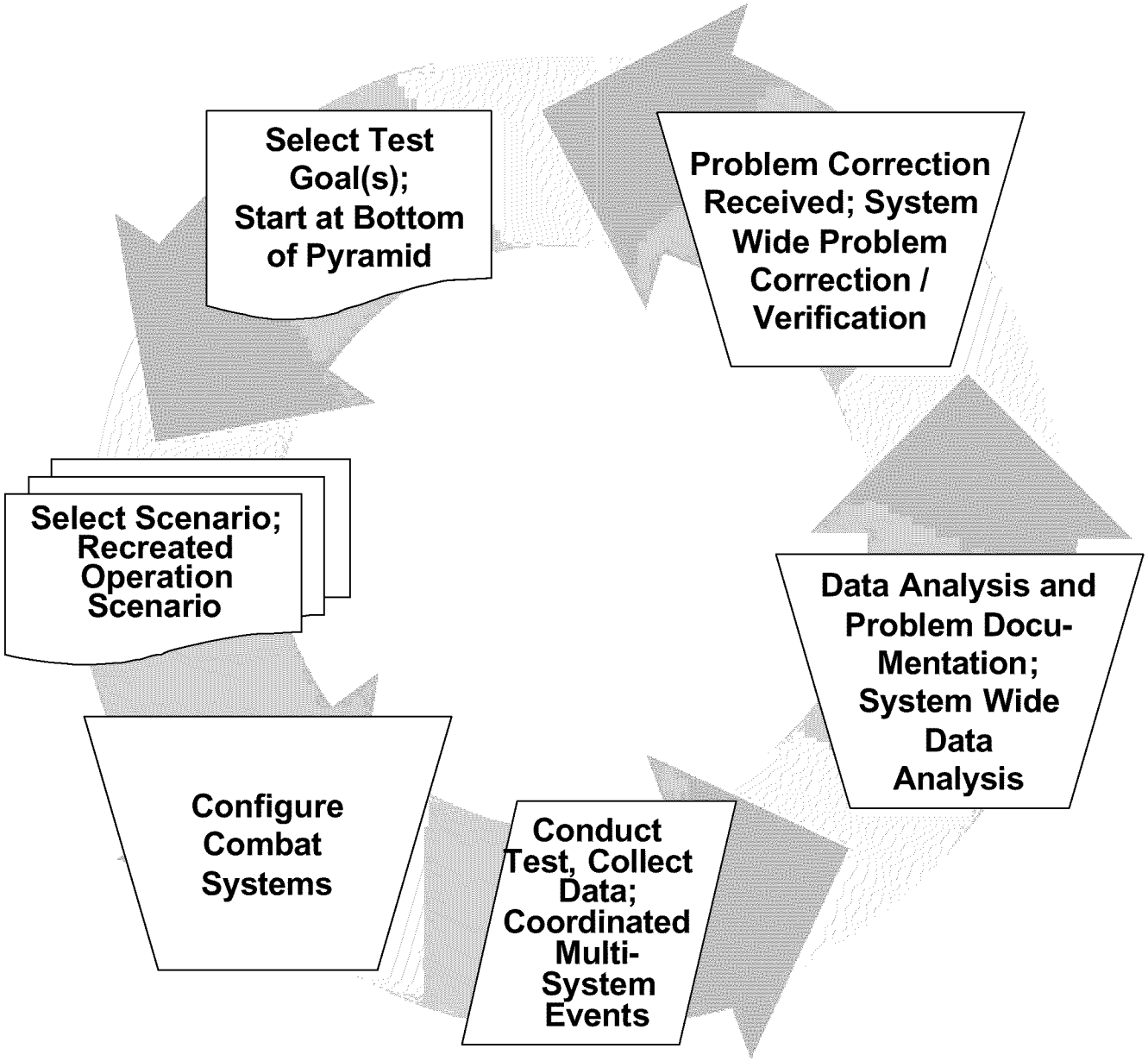
Temp 801 Based Criteria



Level Definition (Abridged)

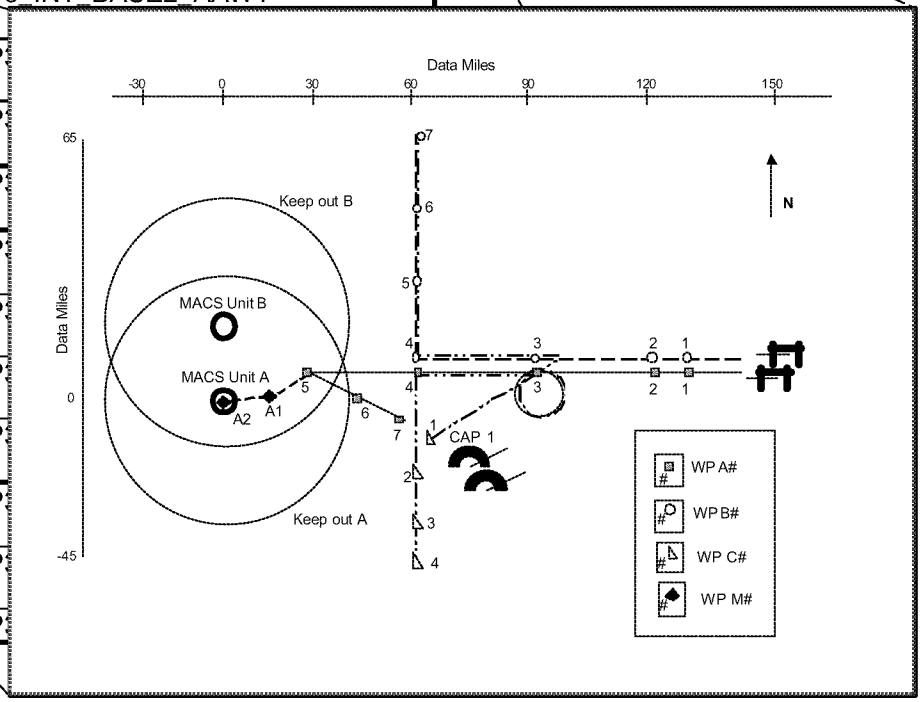
- *Engagement Support / Coordination:* Exploitation of integrated tack data and connectivity to support and coordinate air / TBM engagements
- *Track Integration:* The fusion of local and remote sensor data and track parameters (correlation, decorrelation, mutual tracking)
- *Information Management:* The storage and management of local and remote track parameter data (ID, IFF, etc.)
  - *Data Registration:* The corrective alignment of local and remote track position and kinemetic data
  - *Data Exchange:* The sharing of data at the element and unit level
  - *Developmental Testing:* Verification of MACS test architecture and procedures

Test Process



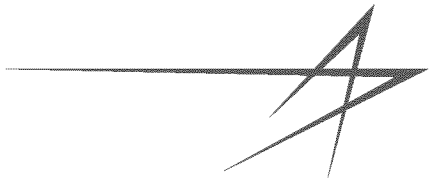
ACSIS Scenario Used for Data Registration Testing

Scenario	Permutation	Section	Recommended script name
1. Baseline AAW	1. Single threat (bandit A)	A2.1.1.1	6P3_INT_BASE_AAW1
1. Baseline AAW	2. Single threat (bandit B)	A2.1.3.1	6P3_INT_BASE_AAW2
1. Baseline AAW	3. Dual threat (bandit A & B)	A2.1.3.2	6P3_INT_BASE_AAW3
2. Baseline AAW mode swap	1. Single threat (bandit A)	A2.2.1.1	6P3_INT_BASE2_AAW1
2. Baseline AAW mode swap	2. Single threat (bandit B)	A2.2.3.1	6P
2. Baseline AAW mode swap	3. Dual threat (bandit A & B)	A2.2.3.2	6P
3. Dual-Axis AAW threat	N/A	A2.3	6P
4. Modified Dual-Axis AAW threat	1. Single ASCM salvos	A2.4	6P
4. Modified Dual-Axis AAW threat	2. Two ASCM salvos	A2.4	6P
4. Modified Dual-Axis AAW threat	3. Three ASCM salvos	A2.4	6P
4. Modified Dual-Axis AAW threat	4. Four ASCM salvos	A2.4	6P
5. Baseline HVA AAW	1. Two ASCM salvos	A2.5	6P
5. Baseline HVA AAW	2. Four ASCM salvos	A2.5	6P
5. Baseline HVA AAW	3. Six ASCM salvos	A2.5	6P



Data Registration Testing:

An Example

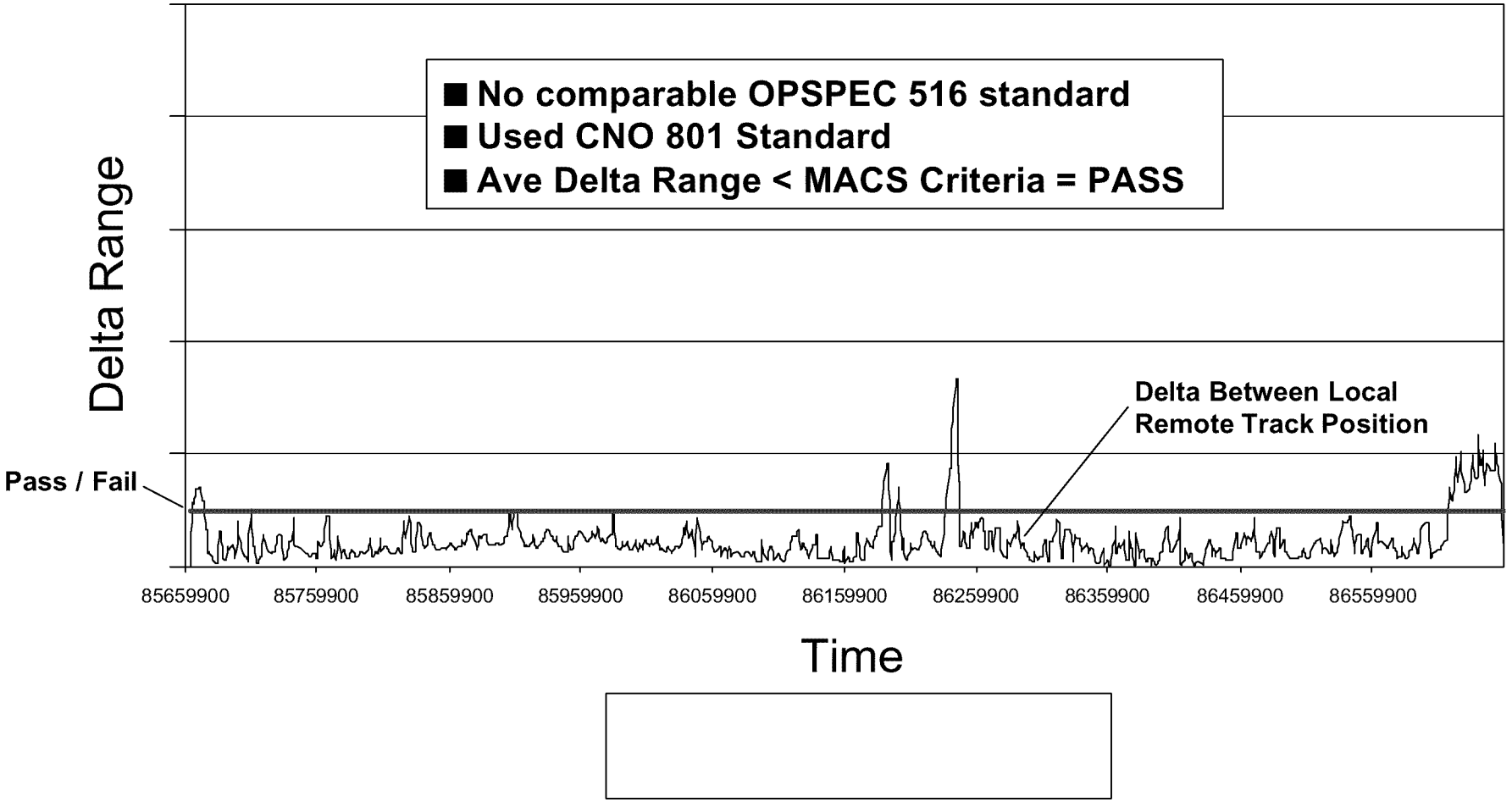


- MACS test matrix identifies 11 priority link specific data registration test goals and pass / fail criteria for:
  - Relative Gridlock
  - IU Registration
  - Sensor Registration
  - Developed ACSIS DIS scenario to inject sensor error that requires compensation using data registration

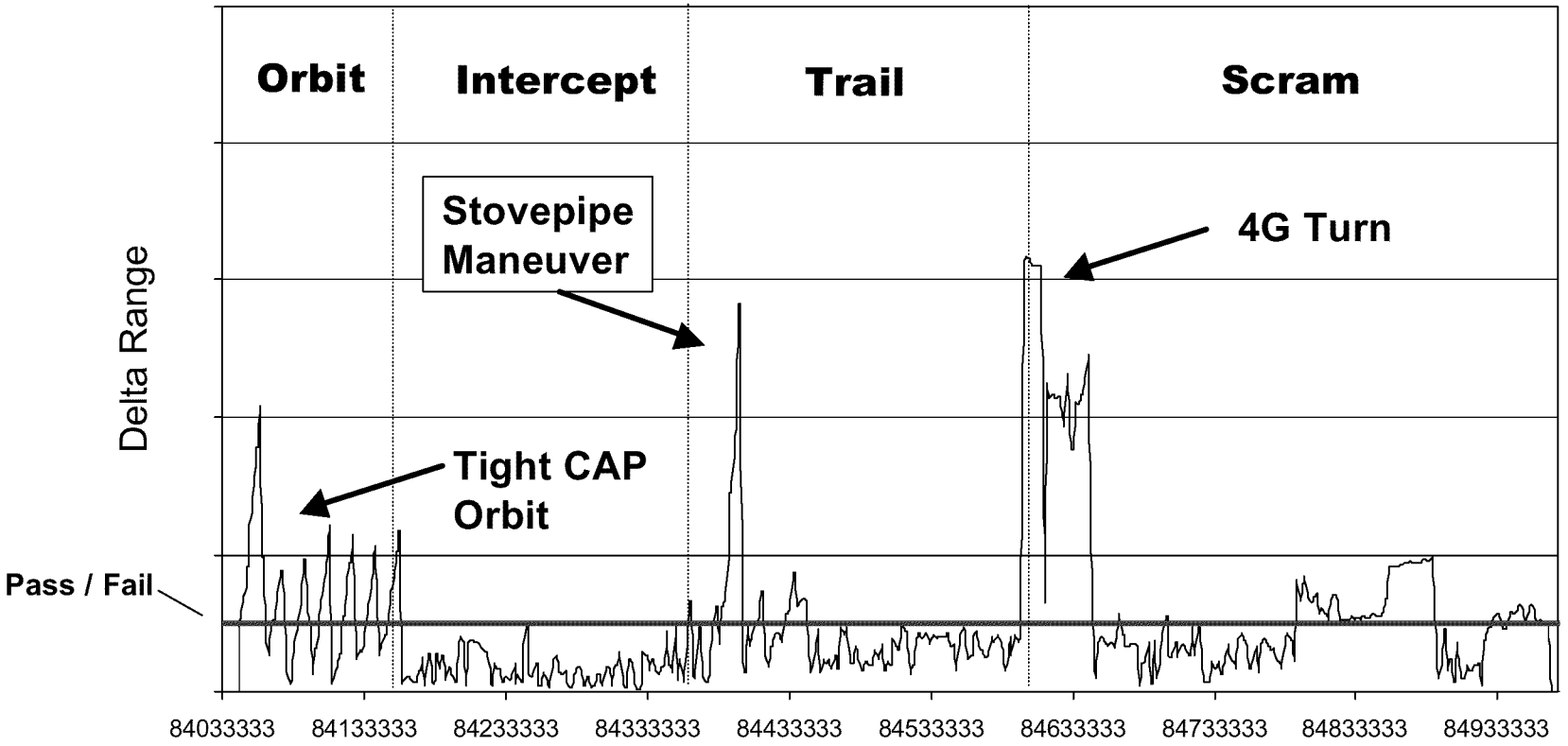
- Initial results
  - **Failed on visual inspection:** Tracks jumped wildly while conducting relative gridlock throughout scenario
  - Data analysis identified C2PR N-1-3033, SGS / AC Sensor Registration application and C&D program problems
  - All fixes verified
  - Basic Relative Gridlock, IU Registration, and Sensor Registration functionality passed

Success Story, But Required Five Month Iterative Process

Relative Gridlock Test Result: Aegis-Aegis Mutual Track

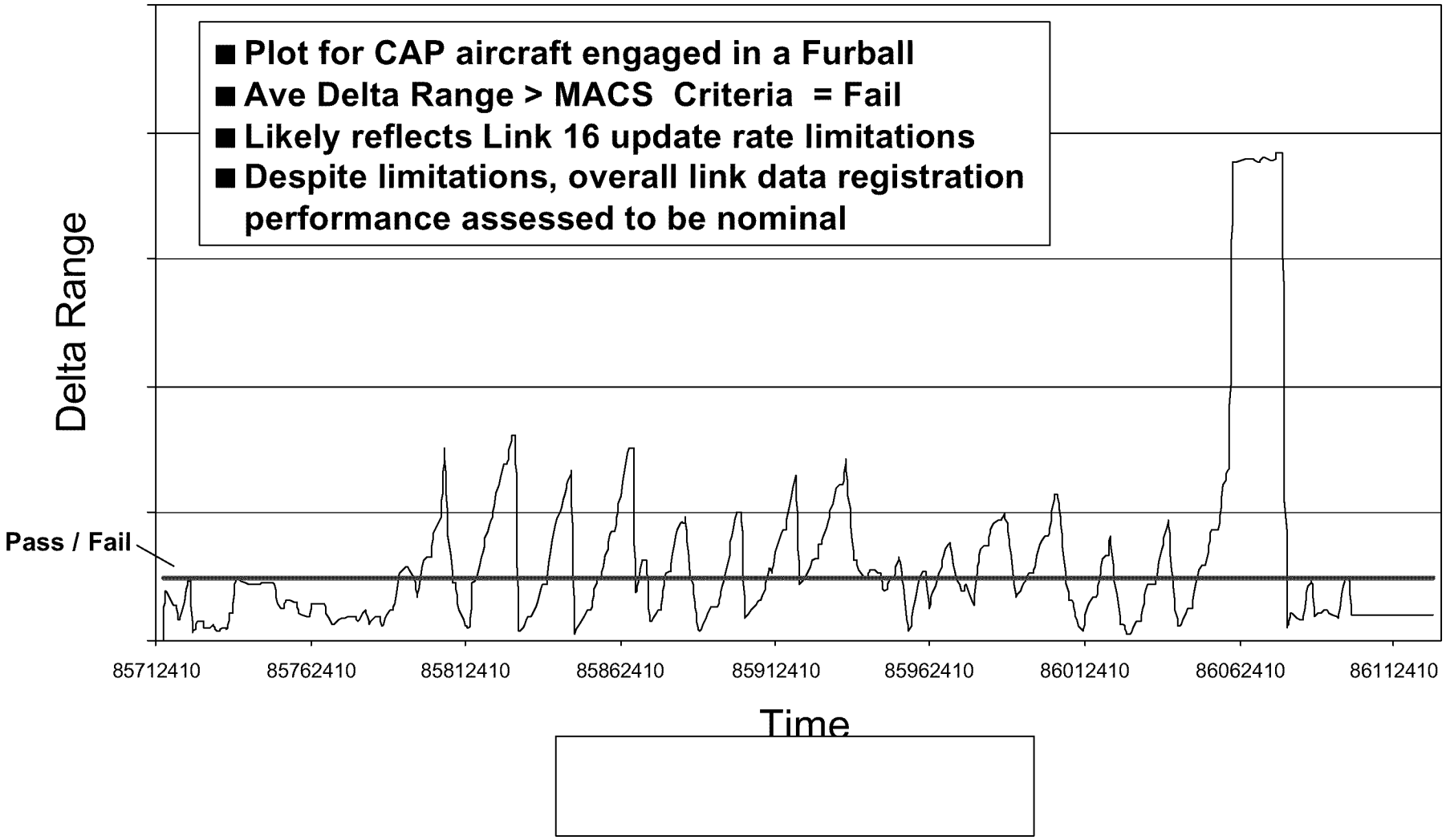


Sensor and IU Registration Results

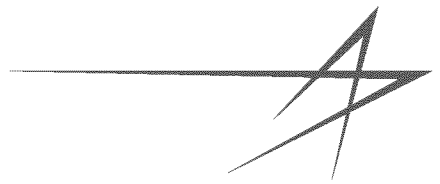


- Maneuvering CAP aircraft
- Avg Delta Range < MACS Criteria = PASS

Sensor and IU Registration Limitations



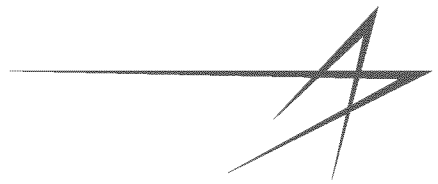
MACS Lessons Learned



- *Developmental testing should be conducted in small doses with limited objectives*
- *Test configuration very challenging*
  - *Most resource intensive test configuration we employ*
  - *Developmental testing demands large test time investment per test objective*
- *Test architecture needed thorough testing and debugging*
- *Testing generates heavy data analysis demands*
- *DIS essential for TBMD interoperability testing*

Finding and Fixing Interoperability Problems is an Iterative Time Consuming Process

Summary



- *Lockheed Martin NE&SS-Surface Systems initiated MACS testing in response to PMS 400B direction to "improve interoperability"*
- *Infrastructure developed and testing in progress*
- *Experienced growing pains*
- *Testing has exposed problems that otherwise would be difficult to find or collect data on*
- *The use of DIS architecture has proven a necessity for TBMD interoperability testing*
- *Test shortfalls that affect ability to find and quickly resolve problems*
  - *Architecture / equipment*
  - *Analysis tools*
  - *Availability / participation of all elements developers*

Interoperability is Not a Goal, It's a Process